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Diesel Railway Traction

Paris–Berlin Express

WIDE publicity has been given within the past three weeks to a statement that it is planned to introduce next year a Paris-Berlin diesel-electric express to be worked by trains of the new Nord triple-unit type described in the issue of this Supplement for July 13. The story seems to have originated with a German publication, but although it has been repeated in such a highly-respected journal as the *Koelnische Zeitung* and given prominence in at least one British semi-technical paper of standing, a direct reference to the company owning the trains in question brought forth the reply that this was the first that had been heard of the matter. Nor can this reply reasonably be doubted—even by the most naïve. That two trains which went into regular revenue service for the first time on July 27 should, less than a month later, be earmarked to cover a daily journey between Paris and Berlin during the summer of 1935, would normally call forth an expression of surprise—even allowing for the fact that ten similar units have since been ordered—which would, however, be nothing to the astonishment which would justifiably be expressed that within this same period preliminary arrangements should have been made for running a 725-mile super-speed daily international service with entirely new vehicles over the lines of three companies in three different countries. Nevertheless, the time will doubtless come.

Progress in Railcar Design

THE enormous field of the railcar in providing efficient and economical operation on branch lines, and in secondary or main line stopping services has brought forth within the last few years an advance in design which, if including no sensational features, is none the less remarkable. Not alone in the engine and transmission equipment have vital improvements been effected. The use of high-grade steel, light metals, welding, and other progressive methods of design and construction, has ensured that the mechanical portion has not lagged behind the developments carried out in the engine and transmission system. Consequently, the most modern examples of railcars in this class not only possess correct tractive effort and speed characteristics, and the ability to stand up to their work, but also form popular operating units with the traffic department in that they show a high seating and power capacity per ton of weight—in addition to the increased revenue which is always brought by a smartly-kept and smartly-worked stud of railcars. Figures extracted from a dozen European railcars built during 1934 for the above-mentioned types of traffic, show that the average tare weight per seat is 560 lb. (with a maximum of 665 lb.), and the average b.h.p. per ton of tare is 9·5 (with a minimum of 7·1), values which are approximately 40 per cent. better than those relating to vehicles of the 1930-32 period, although obtained in conjunction with a greater service availability. The realisation of a low weight per seat has in a few instances been assisted by a horizontal diesel engine located, together with its transmission system, entirely below the floor, and it is likely that more will be heard of this arrangement in the future, for it enables the maximum amount of space to be devoted to revenue-earning, and does not interfere with the accessibility of the power unit. An installation of this type, incorporating an up-to-date light-weight engine running at 1,600 r.p.m., is described elsewhere in this issue, and is further noteworthy for the extent to which high-grade steel and electric welding have been employed to reduce the tare weight.

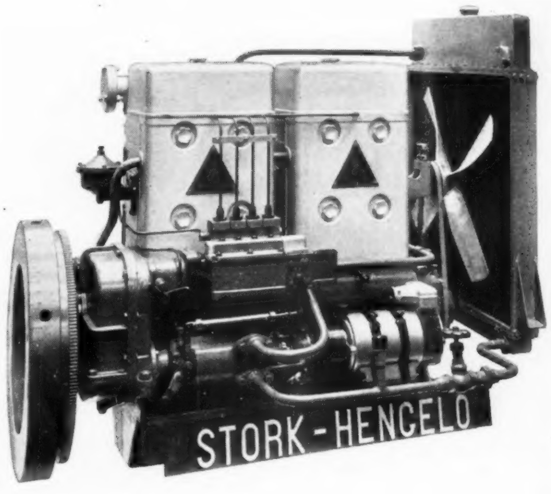
Diesel Conversions

ALTHOUGH fuel cost may not be a large item in the gross operating expenditure, there are certain instances in which it is of sufficient magnitude to warrant the installation of a diesel power plant in a petrol-engined railcar. This may occur where there is a marked difference in the relative prices of crude oil and petrol, but a high yearly mileage may be enough to show a reduction in the fuel bill which will warrant conversion. By no means every application of diesel engines to railway work shows cheaper maintenance costs than corresponding petrol engine installations, but data collected from certain combinations of engine type and duty indicate that this may be attained. Cheaper maintenance added to fuel saving over the relatively low annual mileage of 30,000-40,000 decided the administration of one European railway to convert a couple of dozen petrol cars to diesel propulsion, and in another part of this issue is described a change-over which was brought about solely owing to the magnitude of the saving in fuel cost for a yearly mileage in excess of 100,000. For a satisfactory conversion it is essential that the diesel engine should have as little extra weight and bulk as possible, and that its speed and torque characteristics should not be widely dissimilar from those of the petrol engine which it replaces, thus keeping to a minimum the alterations in the mounting and in the transmission constituents. For a similar cruising range the weight of fuel to be carried is 30 per cent. less, but if the old tanks are retained, fuel adds its quota to the extra weight. Nevertheless, some operating advantages may be gained. In the present state of development, it is almost impossible to avoid an increase in weight if the diesel car is to be capable of maintaining the same service as its predecessor. Thus, while the consumption per ton-mile may go down by 30 per cent., the consumption per train-mile, and the gross consumption, will go down by 26-28 per cent. Another weighty consideration, although not one to which any definite saving can be credited, is the elimination of fire risk in case of accident. The two disastrous collisions involving petrol railcars in France and Italy within the past year resulted in a number of persons being burned to death, but it is worth noting that fire did not follow the recent collision of a steam train and a diesel train in Holland.

NEW LOCO-TRACTORS IN HOLLAND

A dozen diesel-electric vehicles of new design have been built by Dutch firms as a result of successful operation of two trial units

By P. LABRIJN, Chief of Locomotive Department, Netherlands Railways



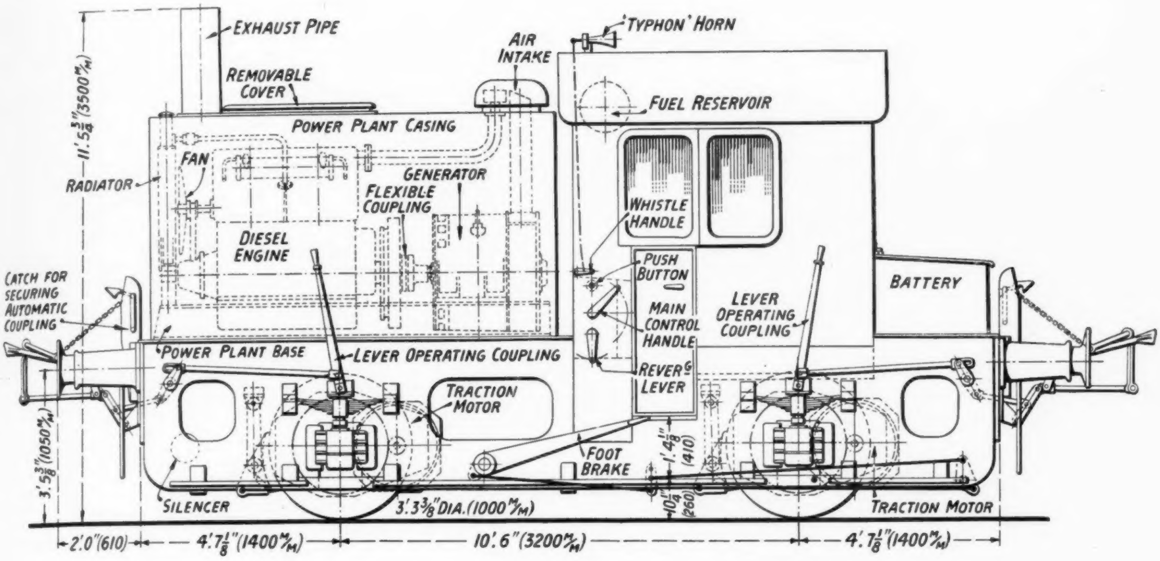
Top: 72/85 b.h.p. Stork-Ganz diesel engine as used in the Dutch loco-tractors
Bottom: General view of one of the new diesel-electric loco-tractors of the Netherlands Railways

FOLLOWING extensive experience with 50 loco-tractors with petrol engines and mechanical transmission, the Netherlands Railways in 1931 introduced two tractors with diesel engines and electric transmission, and these vehicles were illustrated and described in the *Diesel Railway Traction Supplement* for April 20 last. These units have Stork-Ganz engines of 145/160 b.h.p. compared with the 50 b.h.p. petrol engines, but as diesel engines of small power and perfect reliability are now available, it was decided to use this form of motive power when further machines were to be ordered.

As a result of this decision, the 12 loco-tractors put into service within the past two or three months are powered by Stork-Ganz engines of 72/85 b.h.p., built by Stork Bros., of Hengelo. The mechanical portions were constructed by the Werkspoor N.V., at Amsterdam. Nine vehicles have the Gebus system of electric transmission made by Heemaf N.V., of Hengelo, and the remaining three have electric transmission made by Smit's, of Slikkerveer, according to their own designs, the tractors as a whole being to the specification and requirements of the Netherlands Railways.

The diesel engine is of the four-cylinder four-stroke type, developing 72 b.h.p. at 1,000 r.p.m., and having an hourly capacity of 85 b.h.p. at the same speed. The cylinders are 150 mm. (5·91 in.) bore by 185 mm. (7·3 in.) stroke, and at the rated speed the brake m.e.p. is 5·9 kg. per sq. cm. (83 lb. per sq. in.). A pre-combustion chamber of the usual Ganz-Jendrassik type is incorporated, but the atomiser nozzle has an opening of slightly more than one millimetre in diameter, so that no trouble through fouling or choking is anticipated. Owing to the relatively large nozzle, the fuel velocity is low, and this results in less wear of the affected parts. The fuel is forced through the pre-combustion chamber nozzle on to a cam-shaped projection on the piston crown, from which the fuel is sprayed in all directions.

Another feature of this particular make of diesel engine is that when starting up, the air inlet valves are kept closed until the suction stroke is almost completed. This



General arrangement of 72/85 b.h.p. diesel-electric loco-tractor

special operation is required only until the combustion chamber is heated up, the normal valve timing being switched in after about half-a-minute. This system is based on the fact that gases of a certain pressure flowing into a vessel in which a lower pressure exists, undergo an increase in temperature. Calculations show that when air at atmospheric pressure and a temperature of 50 deg. F. is drawn into a vacuum, its temperature is raised to 250 deg. F. The normal compression pressure is 590-600 lb. per sq. in., and the injection pressure 1,150 lb. per sq. in.

A Ganz fuel pump is driven from an intermediate shaft through spur wheels, and is placed on one side of the engine. The injection timing can be adjusted by hand to suit various kinds of fuel. The fuel pump design is such that the discharge stroke is made under the action of springs, and only the suction stroke is governed by the camshaft. With this method the fuel injection is independent of the engine speed and load. Lubrication is effected by a centrifugal pump mounted alongside the crankcase. The circulating water and lubricating oil are cooled in a gilled-tube fan-cooled radiator mounted on the front of the locomotive, as may be seen from the accompanying illustrations.

Transmission System

As the use of mechanical transmission would have entailed the provision of at least five gear steps to attain the maximum desired speed of 60 km.p.h. (37·3 m.p.h.), electric transmission was adopted, and this gives the additional advantage of full power utilisation at all speeds. The diesel engine is attached to the d.c. generator by a Kirchbach flexible coupling, and the two machines are mounted on a solid bed plate. This subframe is mounted on the plate frames of the locomotive with a lining of felt between. The sheet steel casing extending over the whole of the power equipment is insulated with Acoustic-Celotex to reduce noise and vibration. Starting of the engine is effected electrically, a 24-volt battery supplying current to the main generator. The power is transmitted to the wheels through two nose-suspended traction motors.

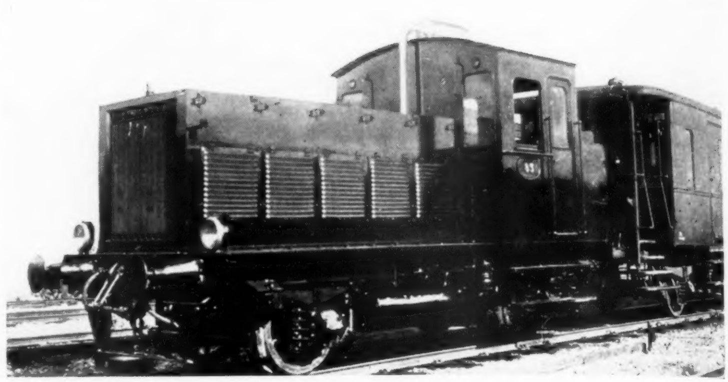
The locomotive can be operated from either side of the cab or from either footboard. For this purpose there are three transverse shafts passing right across the cab, and controlling respectively the direction of running (electric control), the fuel supply to the diesel engine (and through this the electric control shaft), and the whistle. Each cross shaft carries a handle at each end and another in the cab and there is also a pedal on each footboard for the control of the brake, the application of this in the inside of the cab being by means of a hand wheel and screw.

A dead-man handle device is incorporated by means of which the fuel supply is reduced as soon as the pressure on the driver's running lever is reduced, but the apparatus is arranged to be inoperative at speeds below 10 km.p.h. (6·2 m.p.h.), so that in ordinary shunting the driver does not need to keep his hand continuously on the handle. This feature is obtained by the action of the governor balls, which fly out suddenly at approximately the above speed and put the driving handle into the free running position. When travelling at a higher speed the driver must hold the handle to prevent this from happening.

One of the latest Dutch shunting tractors

To permit of the tractor being moved slowly over a short distance, a push button is provided on each side of the cab, and by depressing this, current is supplied to the traction motors direct from the battery. This feature has proved of great use when backing on to a train.

Automatic hook couplers are fitted at each end of the locomotives, and are automatically coupled to the wagon draw-gear when the two sets of buffers come into contact. Uncoupling can be effected from the running boards at each side by means of special levers, but the couplers can be lifted back when it is desired to use ordinary hook or screw couplings. Brake blocks on all wheels are applied by a footpedal, which works in conjunction with a ratchet so that the stroke of the pedal can be multiplied, and thus the full brake force applied, by stepping on the pedal more than once. The proportions of the brake rigging are such that by stepping on the pedal twice, a person weighing 75 kg. (166 lb.) can exert a brake pressure of 12,800 kg. (12·6 tons), equivalent to 61 per cent. of the weight in working order. A Typhon horn is fitted, and is operated by a mixture of compressed air and gas from the diesel engine cylinders which is stored in a reservoir and let out through a reducing valve. The silencer is located between the frames at the forward end.

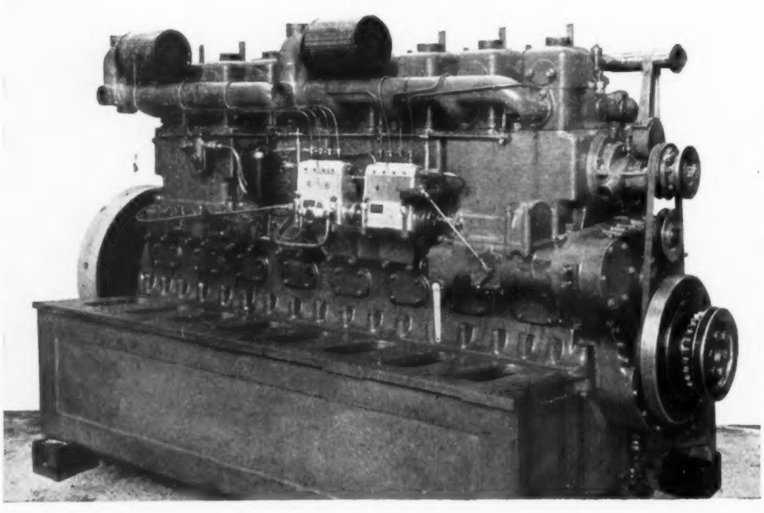


One of the first two diesel-electric loco-tractors of the Netherlands Railways. This machine was built in 1931

Apart from the dimensions given on the accompanying diagram, the leading particulars are as follow: weight in working order, 21 tonnes (20·7 tons); max. axle load, 11·5 tonnes (11·3 tons); max. rail tractive effort, 5,000 kg. (11,000 lb.); factor of adhesion, 4·2; max. speed running light, 60 km.p.h. (37·3 m.p.h.); radius of smallest curve 50 m. (164 ft.); fuel capacity, 100 litres (45 gal.). Tests have shown that when hauling a dynamometer car, a speed of 40 km.p.h. (24·8 m.p.h.) could be attained in one minute in a distance of 0·5 km. (0·31 miles), and 50 km.p.h. (31 m.p.h.) in 2·4 min. in a distance of 1·5 km. (0·93 miles). Trains of 400 tons weight can be started and hauled by these tractors.

LIGHT DIESEL LOCOMOTIVE FOR OVERSEAS

A standard design for narrow-gauge railways of light construction has been evolved by a British firm



McLaren 150 b.h.p. engine. This is of the same type as the 75 b.h.p. unit installed in the Hunslet overseas locomotive

A GOOD market for light diesel locomotives of sound design and construction exists in the requirements of mines, quarries, plantations, and general works, more especially abroad, where the nature of the traffic does not warrant lines of first class construction or of a permanent character. More than one example of this type of unit has been described in the pages of this Supplement, and the Hunslet Engine Co. Ltd. has just brought thoroughly up-to-date an old and well-tried design in which the incorporation of standard parts in locomotives of all gauges from 60 cm. to 3 ft. 6 in. is a prime feature, and in which accessibility has been given every consideration.

Intended for service in South America, the first unit of the new type has just been supplied by the makers through Robert Hudson Limited. It is of the six-wheeled gear transmission type and runs on a gauge of 2 ft. 6 in. It is of simple and rugged design, and the number of auxiliaries has been cut down to the minimum in order to assist in reliability of operation and ease and cheapness of maintenance. By these means, the first cost of the locomotive also has been considerably reduced.

The main locomotive frames are of the plate type and run the full length

between the buffer beams. In the accompanying illustration their transverse spacing may be picked out by the upward projection of the front buffer beam. These frames carry the diesel engine and three-speed gearbox, and are supplemented by two channel sections on each side. The first of these is mounted vertically and takes the place of the running angle; the second channel is horizontal, with the webs pointing downwards, and takes the weight of the springs and also the side thrust of the wheels when passing round curves. These channels are strongly braced to each other, to the main plate frames, and to the buffer beams.

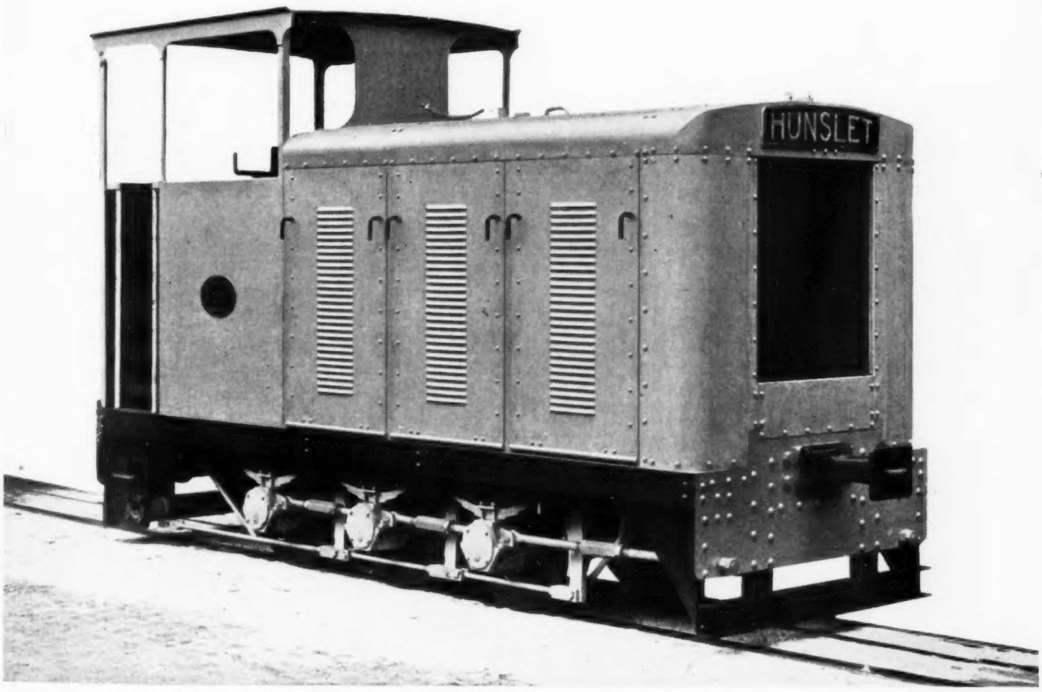
Although having brasses of the normal pattern, the axleboxes are unusual in being steel stampings, and also by reason of the fact that they do not run in ordinary guides or horns. The springs are mounted directly on top of the boxes and their ends bear against steel pads in the horizontal channels, and have pins underneath for use when lifting. The torque reaction of the driving members is taken up on the front buffer beam through the medium of the rods which lead from the tops of the axleboxes. As these rods are adjustable—by means of right and left-handed threads—they form a convenient method of adjusting the axleboxes.

All wheels are braked by the usual type of hand brake, but to render easier the manipulation of the locomotive during shunting, a powerful brake is incorporated in the transmission system, and this is operated by a hand lever in the cab. The wheels are of the disc type, 2 ft. 0 in. in diameter, and are spread over a base of 5 ft. 2½ in.; the total length of the locomotive is approximately 14 ft., the overall width 5 ft. 1 in., and the maximum height 8 ft. 9 in. In working order the weight is 10 tons, and assuming an initial resistance for the wagon stock of 20-22 lb. per ton, the locomotive is able to start a load of over 200 tons. Sanding gear is fitted to the outside of the leading and trailing wheels, and is hand operated from one side of the driver's cab.

Motive power is provided by a four-cylinder four-stroke McLaren engine developing 75 b.h.p. at 1,000 r.p.m., which rating is capable of a temporary increase to 82 b.h.p. at the same speed. C.A.V.-Bosch fuel injection equipment is provided, and the engine is started in the favourite Hunslet method, viz., by means of a small Scott two-stroke petrol engine, which automatically engages and disengages with the starting gear on the main engine. The petrol engine is located within the casing, alongside the main engine, and is started by hand from the cab. The main engine circulating water is passed through a fan-cooled Reliance radiator on the front of the locomotive, as can be seen from the illustration on this page.

The clutch is of the Hunslet patent multiple disc type, and from it the engine torque is transmitted to the gearbox by a flexible coupling. The gearbox is of welded construction and forms a massive frame stay. It contains constant-mesh gearing with wheels of casehardened nickel-chrome steel. Heavy dog clutches are used in the gearbox, but the changing is not automatic, being operated directly by the driver. Both the gear change and reversing levers are placed in convenient positions in the cab. The final drive from the gearbox is by a Renold-Coventry chain to the rear axle, and thence by similar coupling chains to the intermediate and leading axles. The starting, clutch, and driving gear are all interchangeable for any gauge within the range mentioned at the beginning of this article.

With normal engine revolutions the three-speed gearbox gives road speeds of 5, 8½, and 12 m.p.h., with corresponding tractive efforts of 4,780, 2,810, and 1,990 lb., the factor of adhesion in bottom gear being 4·7.



Hunslet 75 b.h.p. diesel-mechanical locomotive for light overseas lines

LIGHT DIESEL CARS FOR SWITZERLAND

New type of vehicle now under construction is similar to the latest electric coaches

WITH a view to speeding up services on certain non-electrified lines near the French frontier, the Swiss Federal Railways have ordered two diesel railcars the design of which differs widely from the diesel units now in service on those railways. The layout of the new vehicles is shown in the accompanying diagram, from which it will be seen that the general lines are very much the same as those of the new single-phase electric motor coaches described in the *Electric Railway Traction Supplement* for July 27.

Streamlining has been adopted in order to permit of the maximum speed of 125 km.p.h. (78 m.p.h.) being attained by a rapid acceleration without the necessity of a very powerful engine. On an estimated tare weight of 29·5 tonnes (29 tons) will be carried a total of 70 passengers, or a ratio of 420 kg. (932 lb.) per seat, and the 290 b.h.p. engine will give 10 b.h.p. per ton of tare, or 8.3 b.h.p. per ton when fully laden.

An extensive use will be made of light metals and alloy steels in the construction of the underframe and body. The bogie centres will have a pivoting function only, as the weight of the superstructure is to be carried directly on laminated springs secured to the bogie frame. The body will be divided into smoking and non-smoking saloons entered from end doors, and will be fitted with lavatory accommodation. Seating accommodation for 52 passengers will be provided in the saloons, and 18 folding seats are to be fitted in the end gangways. The seats will be of the non-reversible type built up on tubular steel frames. Ventilation and heating will be effected by blowing air through the car and inserting an electric heater in the circuit during cold weather. A driving compartment is to be provided at each end, and the controls and auxiliary equipment in each will be duplicated. Hand and air brakes with a braking force of 85 per cent. of the tare weight are fitted, but the electro-magnetic brake of the electric coaches is not used.

For use in these cars, Sulzer Bros., of Winterthur, have developed a new type of light weight four-stroke diesel engine which develops a continuous output of 290 b.h.p. at 1,450 r.p.m. in six cylinders, and has a capacity of 320 b.h.p. at the same speed for half-an-hour. The engine torque will be transmitted to the wheels of one bogie by mechanical transmission with oil-operated gears built by the Swiss Locomotive Company and a Sandner clutch. Engine starting and the drive of the auxiliaries are to be effected electrically, and for this purpose a small generator and a 450 amp. hr. battery will be installed. These two items will supply current to the starting motor, compressor and fan motors, and to the lighting equipment, the generator functioning only when the engine is running.

It is understood that these cars will at first run on the Soleure-Morat-Palezieux-Vevey line, but if successful it is probable that further units will be built and a diesel service inaugurated on other lines where the nature of the traffic does not make worth while the extension of electrification.

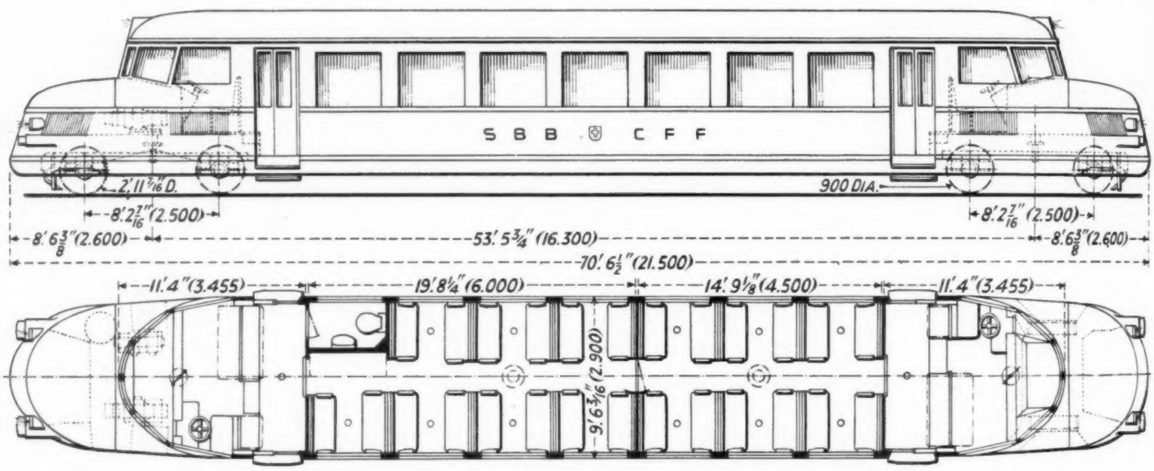


Diagram of new fast diesel-mechanical railcars, Swiss Federal Railways

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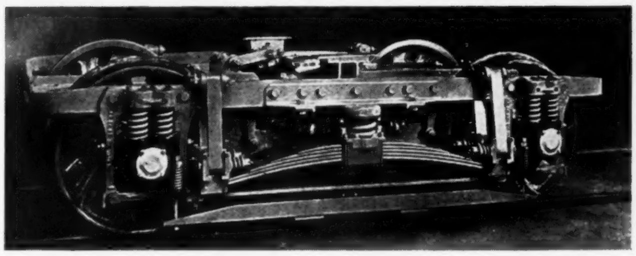
MAYBACH DIESEL RAILCARS.—From Mr. Ernst Schneider, of 18, Victoria Street, London, S.W.1, the British representative of Maybach Motorenbau G.m.b.H., of Friedrichshafen, we have received a well-produced brochure illustrating and describing the numerous Maybach-engined diesel railcars which were set to work in the years 1923-1930, which may justly be termed the trial period of diesel traction. Upon the performance of the vehicles described has been based the design of the Maybach 210, 410, and 820 b.h.p. diesel railcars which have been built in large numbers during the last three years, but it is interesting to note that many examples of the 150 b.h.p. design built in 1924-27 have been increased in power to 175 b.h.p. by raising the revs. and improving the combustion.

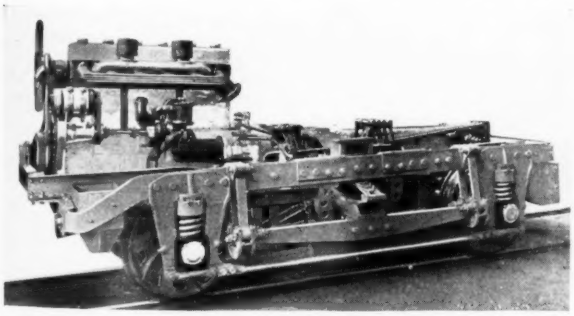


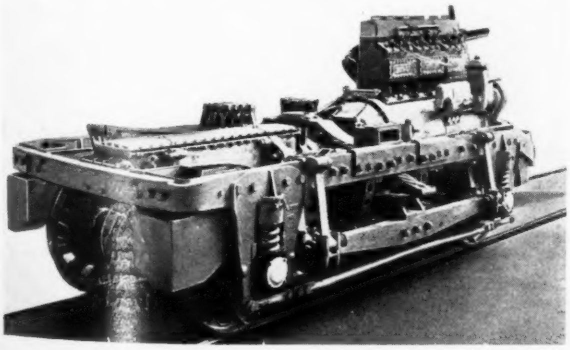
Top: General view of new 135 b.h.p. diesel-mechanical railcar belonging to the Congo-Ocean Railway

Bottom: New design of Brill carrying truck as fitted to the Congo-Ocean diesel railcars

NEW AFRICAN CARS

ALTHOUGH small petrol-engined railcars were used by the newly-opened Congo-Ocean Railway in French Equatorial Africa during it construction, and for operating a passenger service up to the advancing railhead, diesel railcars have now been introduced, and the petrol vehicles relegated to the light and unimportant services. The vehicles which have recently been shipped from France are powered by light-weight high-speed six-cylinder Berliet engines developing 135 b.h.p., and this is the first application of this make to rail traction service. Mechanical transmission is embodied, and the engine, clutch, and gearbox are all mounted directly on the driving bogie, which is of the new B.F.10 pattern designed and built by the Compagnie J. G. Brill, of Paris. The constructional details of this bogie, which run on four wheels of 700 mm. (27·5 in.) diameter spread over a base of 2·35 m. (7 ft. 8½ in.), can be seen clearly in the accompanying illustrations. The carrying bogie has also been designed and built by the same firm, and has wheels of the same diameter spread over a base of 1·8 m. (5 ft. 11 in.). The driving bogie is braked pneumatically and electro-magnetically, but the carrying bogie is fitted with a handbrake only. Following normal Brill practice, the bogie is built up of forgings, sections and gussets of boiler quality steel. Light sheet steel sandboxes are attached to each corner of the frames, and the power units are mounted on a sub-frame of channel sections. Similar methods of construction have been applied to the carrying bogie, except that a single laminated equalising spring is fitted down each side.

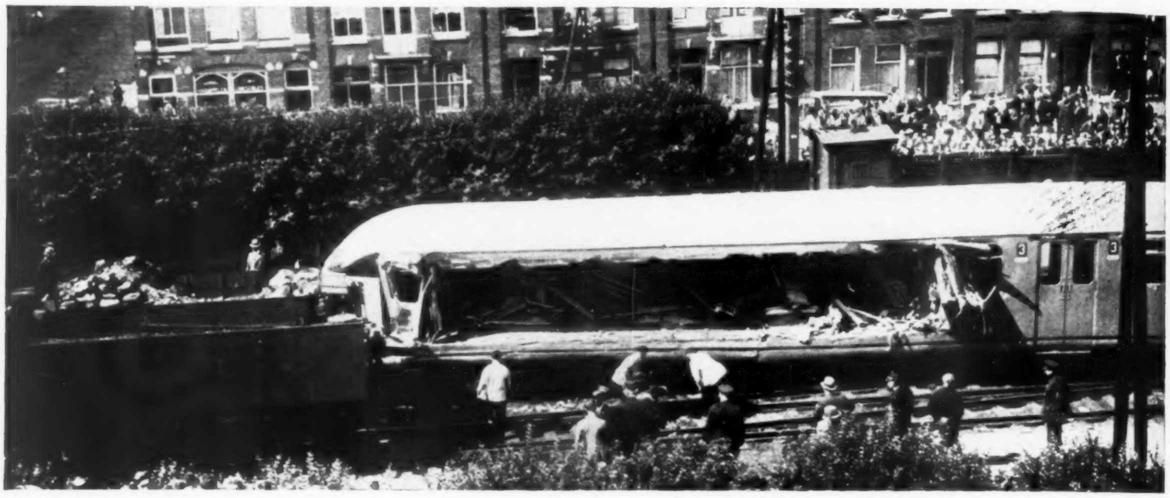




Left: Two views of the new type of Brill truck forming the driving bogie of the Congo-Ocean Railway diesel cars. The Berliet diesel engine and the gearbox are mounted directly on the bogie frame structure. The bolster is supported on two side beams carried by swing links arranged outside the main frame member, with intermediary double laminated springs. The load on the axleboxes is transmitted through helical springs bearing on the axlebox guides

The 820 b.h.p. diesel-electric triple-articulated train involved in an accident with a steam-hauled train at Amsterdam

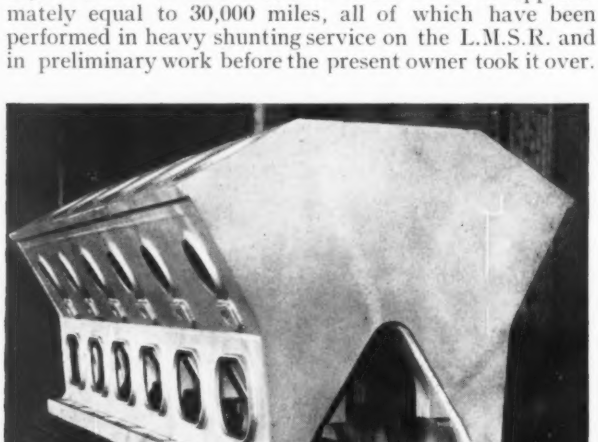
NOTES AND



European Diesel Enquiry.—The Franco-Hellenic Railway is enquiring for three railcars, the type of motive power for which is left to the makers to select. It is understood that terms which will include partial payment in kind will be given preference.

And How! Mr. M. J. Cary, speaking as a layman, and not as an engineer, explained that, as shown in the sketch supplied to members, a diesel train was one driven from both ends by electricity generated by means of an internal dynamo.—*From a report on the debate on diesel traction in the Ceylon State Council.*

L.M.S.R. Diesel Locomotive.—The first of the L.M.S.R. diesel-mechanical shunting locomotives, that fitted with an M.A.N. engine and built by the Hunslet Engine Company in 1932, has been returned to the maker's works and is now undergoing overhaul. It has now about 10,000 hours of actual service to its credit or approximately equal to 30,000 miles, all of which have been performed in heavy shunting service on the L.M.S.R. and in preliminary work before the present owner took it over.



Welded steel crankcase of 1,000 b.h.p. 12-cylinder quick-running diesel engine

More Zephyrs.—The Chicago, Burlington & Quincy Railroad has ordered from the E. G. Budd Manufacturing Company, two further triple articulated high-speed trains, similar in most respects to the Burlington Zephyr illustrated in the issue of this Supplement for May 18, but with additional seating capacity consequent upon the elimination of the mail and baggage space. The new trains are to be placed in regular daylight service between Chicago and the Twin Cities (Minneapolis and St. Paul.)

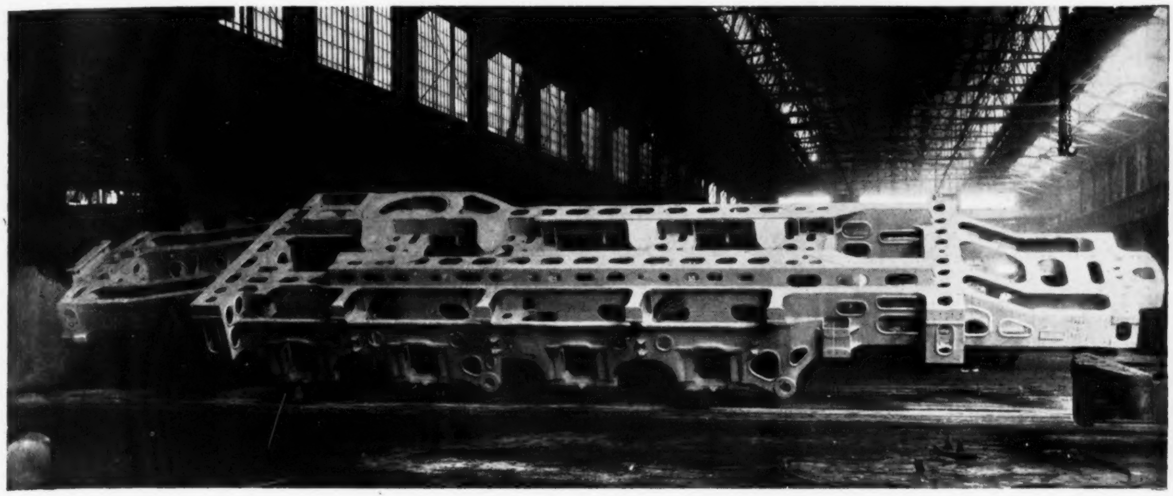
French Diesel Service Acceleration.—The 820 b.h.p. diesel-electric streamlined trains operating on the Paris-Lille-Tourcoing division have been accelerated. They now run from Paris to Amiens, and *vice versa*, 81·1 miles, in 77 min.; an average of 63·2 m.p.h.; from Amiens to Arras, 42·1 miles, in 41 min., an average of 61·6 m.p.h.; and from Arras to Amiens in 40 min., an average of 63·2 m.p.h. When the service was inaugurated in July, these trains did not run into Amiens, but stopped at Longneau, 2½ miles away, on the through Paris-Lille line.

L.N.E.R. Railbus.—The L.N.E.R. has recently purchased the 95 b.h.p. diesel-electric railbus with an Armstrong-Saurer engine, which has been running in passenger service in the Tyneside area for the past 10 months. During this period it has worked 14 hr. a day and covered about 700 miles a week. After purchase, the car was withdrawn from traffic for overhaul at the makers' works, but has just returned to service. It will first be employed on the Yorkshire coast lines, after which it will supplement the regular service on the Newcastle-Carlisle, North Wylam, and Blackhill branches.

The First Diesel Train Collision.—What was probably the first collision, at least of any gravity, in which a diesel train running in regular service was concerned, took place on August 5 at the Wesperspoor station at Amsterdam on the Netherlands Railways. As one of the new diesel trains (see *Diesel Railway Traction Supplement* for May 18), was leaving the station it came into collision with an arriving steam train, the side of the former being caught by the locomotive, which was running tender first, and torn away for a considerable length. Although the car was badly damaged no passenger was killed, but 12 persons had to be taken to hospital. It is stated that the driver of the diesel train ran past a signal at "danger."

NEWS

Cast-steel locomotive bedplate as embodied in the Canadian National Railways 1,330 b.h.p. diesel-electric main-line locomotive



North African Railcars.—The French Government is considering the purchase of 20 diesel railcars for service on the Tunis Railways with a view to reducing the heavy cost of operation. In 1933 the operating ratio of this line was no less than 236.

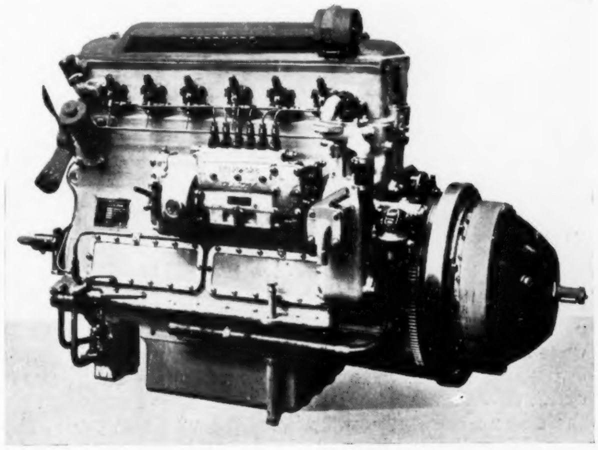
Diesel Locomotive Beds.—Following general steam practice in North America, the 2-Do-1 1,330 b.h.p. diesel-electric locomotives of the Canadian National Railways, which were illustrated in the issue of this Supplement for August 10, are built up on a frame cast in one piece with which various fittings and auxiliaries are integral. Cast by General Steel Castings Corporation, each locomotive bed, as illustrated herewith, weighs approximately 18 tons in the machined condition, extends over a length of 46 ft. 1¾ in., over a width of 9 ft. 10 in., and over a depth of 5 ft. 0 in.

Proposed Japanese Flyer.—According to the Japanese press, a streamlined pneumatic-tyred train driven by two internal combustion engines with a total output of 1,500 b.h.p. is to be introduced next year on the Tokaido route of the Japanese Government Railways between Tokio and Kobe. The train will be constructed largely of duralumin, and will carry about 200 passengers of one class. A maximum speed of 100 m.p.h. is envisaged, although the gauge is only 3 ft. 6 in., but the permanent way on the Tokaido route is now laid with 100-lb. flat-bottomed rails and is quite suitable for such a speed. The train will be designated "The Bullet"

Further American High-Speed Trains.—Two more American railroads have announced that a high-speed diesel service will find a place in their timetables in 1935. The Gulf, Mobile & Northern has placed an order with the American Car & Foundry Company for two triple-car streamlined trains and an extra streamlined coach. A 600 b.h.p. diesel engine with electric transmission will form the motive power of each train, and buffet, sleeping, and observation accommodation will be provided. The New York, New Haven & Hartford Railroad has ordered from the Goodyear Zeppelin Corporation a triple-articulated train with a diesel-electric power plant at each end. It is intended to place this unit in service between Boston, Mass., and Providence, R.I., and the 44 miles will be covered in 44 min. inclusive of one intermediate stop at a Boston suburban station.

Mr. H. A. Currie.—Mr. H. A. Currie, the Electrical Engineer of the New York Central Railroad died recently at his Long Island home. It was through the initiative of Mr. Currie that the N.Y.C. acquired 35 oil-electric-battery locomotives for shunting in the New York and Chicago yards, and it was by his courtesy that we published a comprehensive article on the operation of these machines in our issue of February 24 last. Mr. Currie has been succeeded by Mr. W. S. H. Hamilton.

British-Built Engines for Spain.—Two 90 b.h.p. light-weight diesel engines, as illustrated herewith have just been shipped to Spain for service on the Norte Railway, by William Beardmore & Co. Ltd. They are of the four-stroke type, and develop 90 b.h.p. at 1,800 r.p.m. in six cylinders with a bore of 4·25 in. and a stroke of 6·0 in. The accompanying illustration shows a Vulcan-Sinclair fluid flywheel which is being used in conjunction with the mechanical transmission of the two railcars for which these engines are intended.



New Beardmore engine as used on railcars of the Norte Railway of Spain

SEPARATE-COMPRESSION SYSTEM FOR DIESEL LOCOMOTIVES AND RAILCARS

Results of a German investigation into the advantages of separate compression as a means of adapting diesel characteristics to traction requirements

THE limitations of the ordinary diesel motor, in regard to starting under load and dependence of output on speed, have been overcome more or less completely by the use of various transmission systems, all of which utilise the diesel motor itself as a constant-speed prime mover. An obvious disadvantage of the electric, compressed air and hydraulic systems is that equipment amounting to three times the effective power must be carried if the whole of the energy is transmitted by one of these media. This objection is overcome by the separate-compression method of operating the diesel at variable speed, as described in a recent issue of the *Zeitschrift des Vereines deutscher Ingenieur.* Instead of filling the cylinder with slightly compressed air prior to the compression stroke, as in supercharging, or injecting a certain amount of highly-compressed air at the end of the compression stroke, as in supplementary charging, the whole of the air is separately compressed, and forced into the cylinder at the commencement of the expansion stroke. The separate-compression method thus eliminates the compression stroke and makes possible two-stroke operation without a scavenging pump, exhaust turbine or starting coupling. The weight of the auxiliary diesel and compressor required for the separate compression of the air is much lower than that of the auxiliaries required for electric, air or hydraulic transmission, and, at the same time, a close approximation to the ideal traction curve is maintained with a high overall efficiency which varies little within the normal range of operation of the locomotive.

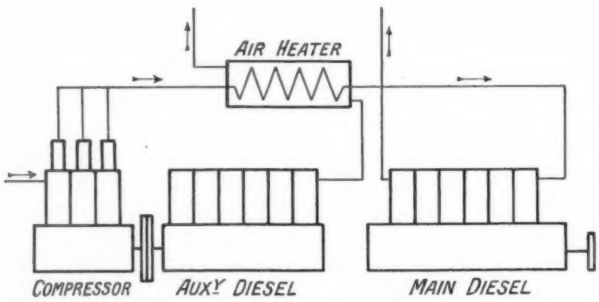


Fig. 1—Diesel power unit arranged with separate-compression system

Equipment Required

Referring to Fig. 1, the equipment comprises the main diesel, an independent compressor driven by an auxiliary diesel, exhaust gases from which heat the compressed air on its way to the main engine. The main motor operates on a two-stroke cycle, which differs from the normal in that there is no compression stroke. The whole of the stroke succeeding the working stroke is available for exhaust, which is effected by piston displacement instead of by scavenging. The supply of compressed air is independent of the speed of the main engine, which can therefore be connected rigidly to the driving wheels and operated by variable admission, like a steam engine.

The auxiliary diesel and compressor have to be capable of developing the compression power, which is theoretically about **34** per cent. of the total power developed by a diesel performing its own compression. The main engine is correspondingly relieved, because the work done by the auxiliary diesel is now recovered as useful output. Hence, taking the maximum output at the crankshaft of the main engine as **100**, the requisite ratings of the machines are theoretically:—

Auxiliary diesel	34
Compressor	34
Main diesel	66
	134

or 1·34 times the main engine output. Actually, this figure must be considerably higher to cover transmission losses, but there is still a substantial saving compared with the treble equipment of electric or fluid transmission systems.

The objection that the exhaust losses increase with increasing admission can be overcome simply and economically in the separate-compression engine by increasing the cylinder capacity. This has no effect on the mechanical and thermal stresses because there is no longer any question of compression ratio, but it is beneficial to the efficiency because the loss by incomplete expansion is considerably reduced.

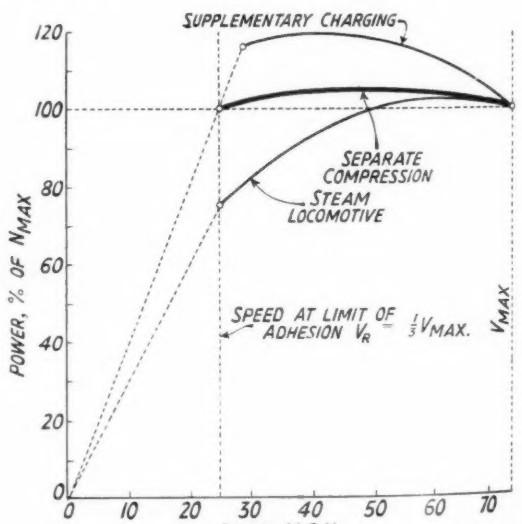


Fig. 2—Power characteristics of steam engine and diesel locomotives with supplementary and separate compression

Comparison of Systems

The ideal is a power line remaining horizontal at all speeds from the limit of adhesion to the maximum speed. For practical purposes, the power characteristic of the

steam locomotive may be taken as a basis of reference, to be equalled or excelled. The power-speed characteristics of the steam locomotive and of diesels with supplementary charging and separate compression respectively are shown in Fig. 2; where $N_{max.}$ denotes the maximum power at the maximum speed $V_{max.}$ The maximum power cannot be developed by the steam locomotive at low speeds, or by the supplementary-charged diesel at high speeds. The Deutz direct-drive diesel locomotive, described in the *Diesel Railway Traction Supplement,* January 26, 1934, page 160, departs from the characteristics of supplementary charging, and results, according to Drs. Grantz and Rieppel, in the less favourable power curve shown in Fig. 3.

As regards weight, the diagrams in Fig. 4 show the indicated power of the machines required on the locomotive, as a percentage of the useful power available at the driving wheels in the respective cases.

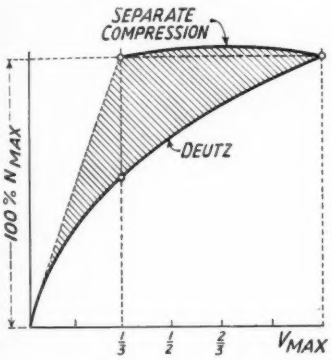


Fig. 3—Power characteristics of Deutz direct-drive diesel locomotive and separate-compression diesel locomotive

The i.h.p. values for the equipment required take account of the efficiency of each machine. In the case of separate-compression, however, the i.h.p. to be considered is not that actually developed by the main engine, but that which would be developed by an ordinary diesel of the same dimensions. The cylinder output where separate compression is employed is greater by the power absorbed by compression in an ordinary engine; also, there is the increased power due to lower expansion, so that the output is about 1·67 times that of the ordinary diesel.

For each 100 h.p. developed at the driving wheels, the engine i.h.p. is: (1) With supplementary charging 135 h.p., assuming 95 per cent. transmission efficiency and 78 per cent. mechanical efficiency. (2) With separate compression 128·2 h.p., assuming 95 per cent. transmission efficiency and 82 per cent. mechanical efficiency. The dimensions of the main engine in the latter case correspond to those of a normal two-stroke diesel of 128·2/1·67 = 76·5 h.p., so that, as regards weight, the comparison is:

	I.H.P. per 100 H.P. at drivers with:	
	Supplementary Charging	Separate Compression
Main diesel	135·0	76·5
Compressor	65·6	56·2
Auxiliary diesel	100·0	85·6
	300·6 i.h.p.	218·3 i.h.p.

The other diagrams in Fig. 4 are determined in similar manner. In the case of the Deutz locomotive, the sum of the machine capacities is about 190 i.h.p. per 100 h.p. at the driving wheels, so that against the less satisfactory power and efficiency characteristics (Figs. 3 and 5) there is

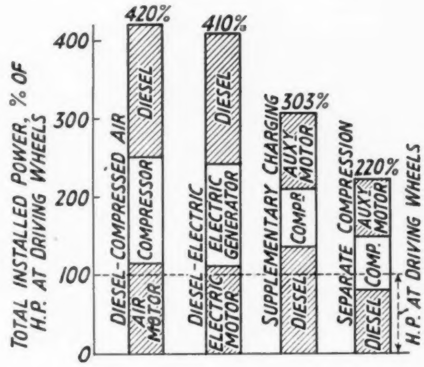


Fig. 4.—Indicated horse-power required on various types of diesel locomotives as percentage of effective output at wheel rims

a saving of about 14 per cent. in the total i.h.p. of equipment required.

Thermal efficiency is not the only argument in favour of diesel locomotives; there are also to be considered independence of water supply, readiness for service, elimination of turntables, tenders, and so on. On the other hand, high efficiency is an advantage, other things being equal, and the curves in Fig. 5 show the favourable performance resulting from separate-compression, compared with supplementary charging and the highest operating efficiencies of diesel-electric (DE) and diesel-compressed air (DD) systems respectively. The authors cite no actual values for the efficiency of the Deutz locomotive, but state that its efficiency curve coincides with that of supplementary charging (Fig. 5) at the maximum speed and falls increasingly below it at lower speeds.

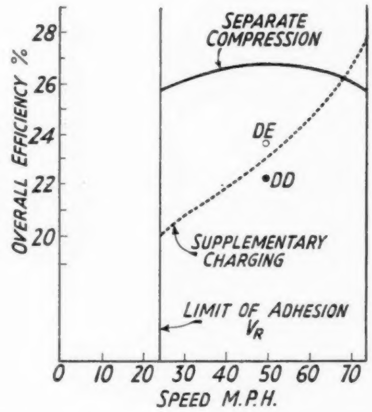


Fig. 5—Overall efficiency at full load with supplementary charging and with separate compression and enlarged cylinder

THE L.M.S.R. RAILCARS.—Reports have just come to hand concerning the performance of one of the light two-axled Leyland railcars with which the L.M.S.R. is operating an additional service, over and above its ordinary services, between Springvale, Blackburn and Clitheroe, in East Lancashire. The interest which this vehicle has aroused among the public is revealed by the fact that between July 2 and August 24 the car travelled no fewer than 10,000 miles, carrying 15,800 passengers, with complete freedom from trouble. Another of these three diesel-hydraulic railcars is about to be transferred to the Scottish division.

DIESEL RAILCAR
REBUILT FROM PETROL VEHICLE ON U.S.A. RAILROAD

Big saving in fuel cost results from installation of oil engine in unit engaged in heavy service

AFTER covering more than **600,000** miles in regular operation over a period of barely six years, one of the heavy double-bogie petrol railcars of the Seaboard Air Line, in the U.S.A., has been changed over to diesel working by the installation of one of the new Westinghouse high-speed engines, and the data collected over **10,000** miles of running show that a saving in the annual fuel cost of approximately **$10,000** (**£2,000**) will be possible if the mileage remains the same as that of the petrol car.

A very good comparative study of the features of the rival types of engine is possible, as the diesel car is responsible for the service which was previously worked by the petrol vehicle, *viz.*, one round trip daily between Savannah and Americus, in the state of Georgia, a total distance of just over **400** miles. As may be seen from the first of the accompanying illustrations, the car is of normal American construction, but no passenger accommodation is provided, the 73-ft. length of the body being made up of a 13-ft. engine and driving compartment, a 15-ft. mail room, and a 45-ft. baggage and parcels compartment. Passengers are carried in an ordinary coach attached at the back end, and the whole combination is capable of running in one direction only.

The prime mover is the first example of the new range of the Westinghouse Electric & Manufacturing Company to go into actual traction service. It is a four-cylinder four-stroke unit of light weight construction and develops **265** b.h.p. at **900** r.p.m. No greater space was required than that taken up by the preceding petrol engine, and only very minor modifications were necessary in the engine room. The existing cooling system, consisting of a fan-cooled gilled-tube radiator in the roof, was retained, but was supplemented by a lubricating oil cooler at the front of the vehicle, the elements of which are cooled by natural draught. The fuel tank was not changed, but owing to the reduced fuel consumption the cruising range of the car is now twice what it was with petrol.

Diesel-electric railcar hauling trailer, Seaboard Air Line

A single welded steel bedplate carries both the engine and the main generator, and is mounted directly on the car sills. Light metals have been largely used for the engine details, and the pistons, individual cylinder head castings, and valve gear casings are of aluminium alloy. The crankshaft is a one-piece forging of nickel steel provided with a vibration damper at the front end. The crank pins and connecting rod big ends are balanced by a prolongation of the crankwebs.

New main and auxiliary generators were necessitated by the conversion, because of the difference in the engine

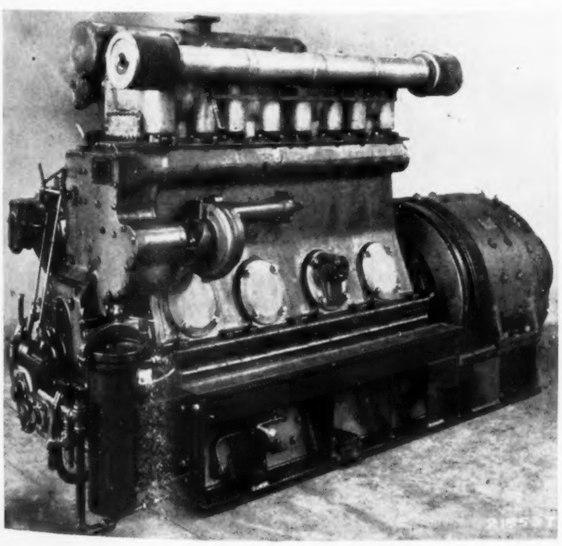
speeds, the petrol engine having developed its rated output at 1,050 r.p.m., but the differential generator characteristic with variable engine speed control, the mechanically operated throttle, and the controller for the motor connections were retained. The engine is started electrically, but when the change over to diesel was made, the existing 16-cell 32-volt battery was supplemented by an additional 16 cells in order to provide for the higher firing speed of the heavy oil engine, but the control and lighting systems still work off the 32-volt supply. Charging of the battery is effected mainly by the auxiliary generator, and due to the relatively great stopping and coasting periods on certain runs, during which the engine is idling, a comparatively high charging rate would normally be necessary. In order to get over this, and prolong the life of the battery by more uniform charging, the engine is governed at a constant speed while idling, and a special winding permits the main generator—now operating at constant voltage—to charge the battery.

Operating Figures

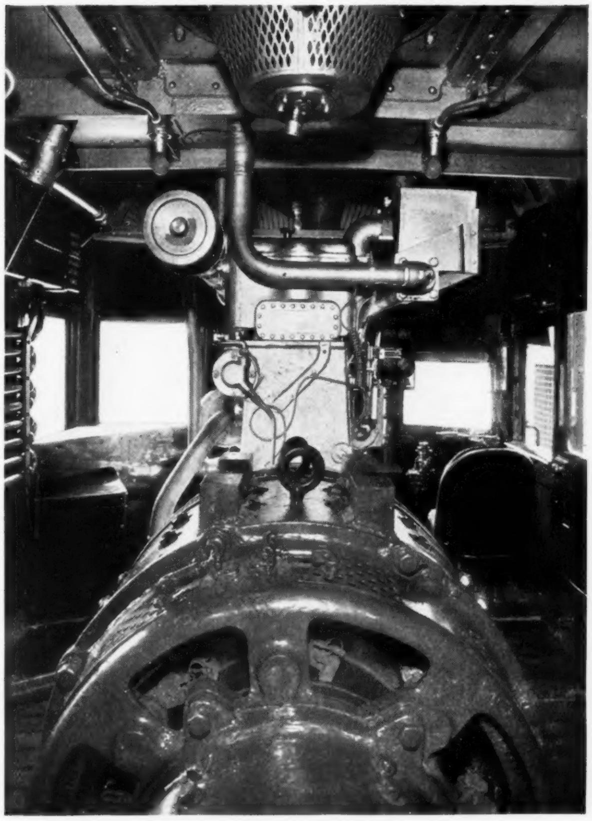
The following table gives particulars of the service operated by the petrol and diesel-electric cars, together with the mileage, fuel and lubricating-oil consumptions.

	Diesel	Petrol
Number of single trips per day ..	2	2
Mileage of single trip	198·6	198·6
Schedule time .. .. out	6 hr. 55 min.	6 hr. 55 min.
home	7 hr. 05 min.	7 hr. 05 min.
Schedule speed .. .. out	28·7	28·7
home	28·1	28·1
Shunting and light mileage ..	2·75	2·75
Total daily mileage	402·7	402·7
Total mileage from which figures are taken	10,000	634,000
Gal. of fuel per day	116·3	240·5
Train miles per gal.	3·45	1·68
Train weight .. .. tons	90·5	83
Miles per gal. of lubricating oil ..	113	110
Fuel cost per gal. .. pence	2·35	7·46
Fuel cost per mile .. pence	0·68	4·43

To British and Continental observers the first point in the above table to strike the eye is the low cost of diesel fuel oil, but the cost of petrol is low also, and the relative value of the two fuels is much the same as it is on this side of the Atlantic. The substitution of a diesel engine



265 *b.h.p. Westinghouse oil engine*



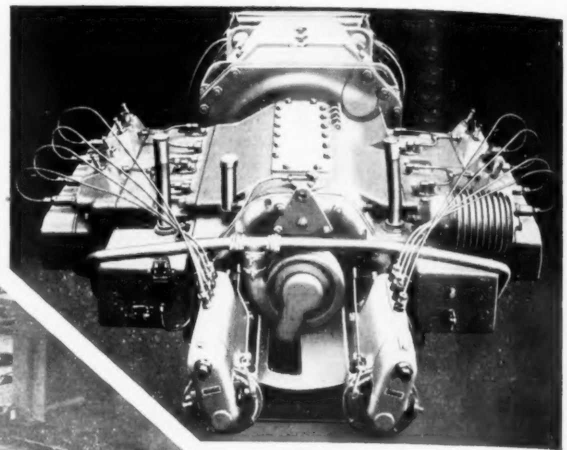
Interior of engine room and driving compartment of diesel railcar on Seaboard Air Line

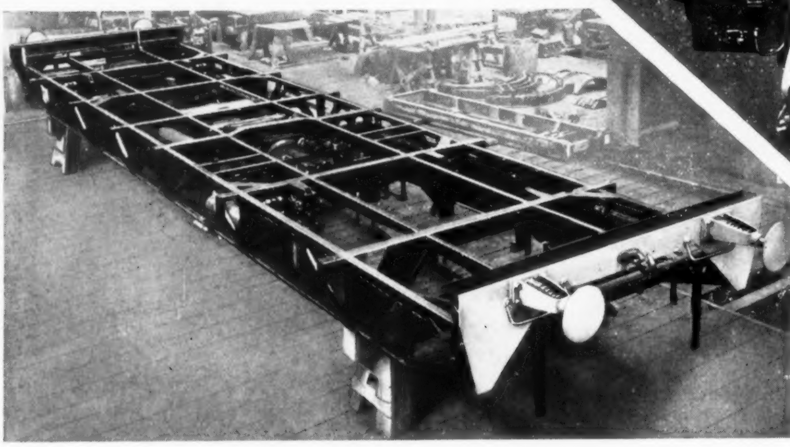
for the original petrol unit has added approximately seven tons to the overall weight. Some of this is due to the heavier engine, some to the main generator, a portion to the heavier battery, and part to the increased weight of fuel, for fuel oil is 25 per cent. heavier than petrol per gallon. Of course, for equivalent cruising range the weight of fuel would be less by almost 30 per cent. The lower volume consumption of a diesel engine is due to its higher thermal efficiency, and to the greater heat content of fuel oil. On the basis of power output the diesel engine is more efficient to the extent of about 30 per cent., typical fuel consumptions being 0·60 lb. per b.h.p. hr. for petrol engines and 0·40 to 0·43 lb. per b.h.p. hr. for diesel units. Preliminary calculations on the Seaboard Air Line were based on relative consumptions of 1 to 2 and so far as the first 10,000 miles of diesel operation show, the actual ratio is slightly better than this, and is 2·26 to 1 on a ton-mile per gallon basis. The old Seaboard petrol railcar made an annual average mileage of 132,000 for a period of nearly five years, and assuming that the new diesel unit maintains the same mileage the yearly saving in the fuel bill will amount to £2,060.

A NEW DIESEL FUEL.—Tests are now being carried out by the South Manchuria Railway at Mukden with a view to using both Fushun shale oil and soya bean oil as a fuel for diesel engines. Trials with a European diesel engine indicate a possibility of soya bean oil being made into a commercial fuel. This would not only render Manchukuo independent of foreign supplies, but would also form a new market for the country's staple product.

RAILCARS WITH HORIZONTAL ENGINES

Advanced designs in Czechoslovakia





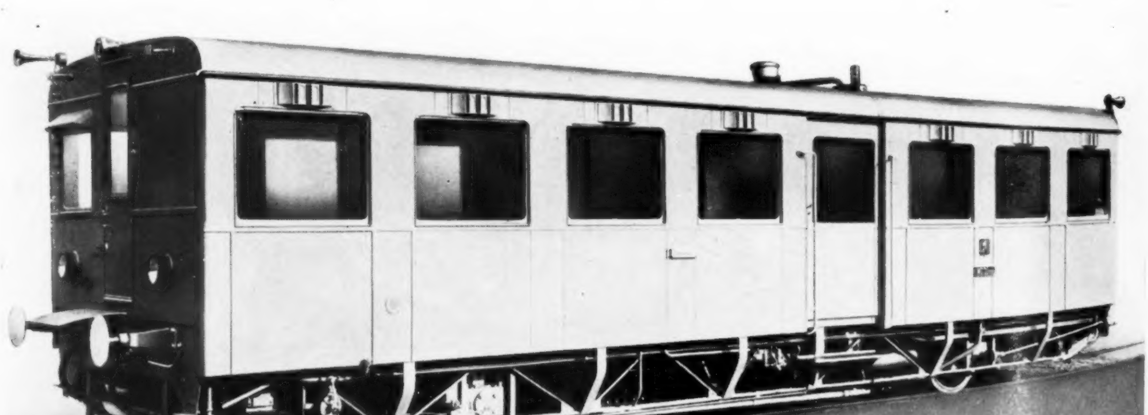
***Above:* Eight - cylinder 120 b.h.p. horizontally-opposed diesel engine**

***Left:* Welded steel underframe of light Czechoslovak diesel railcar, showing location of horizontal engine and main generator**

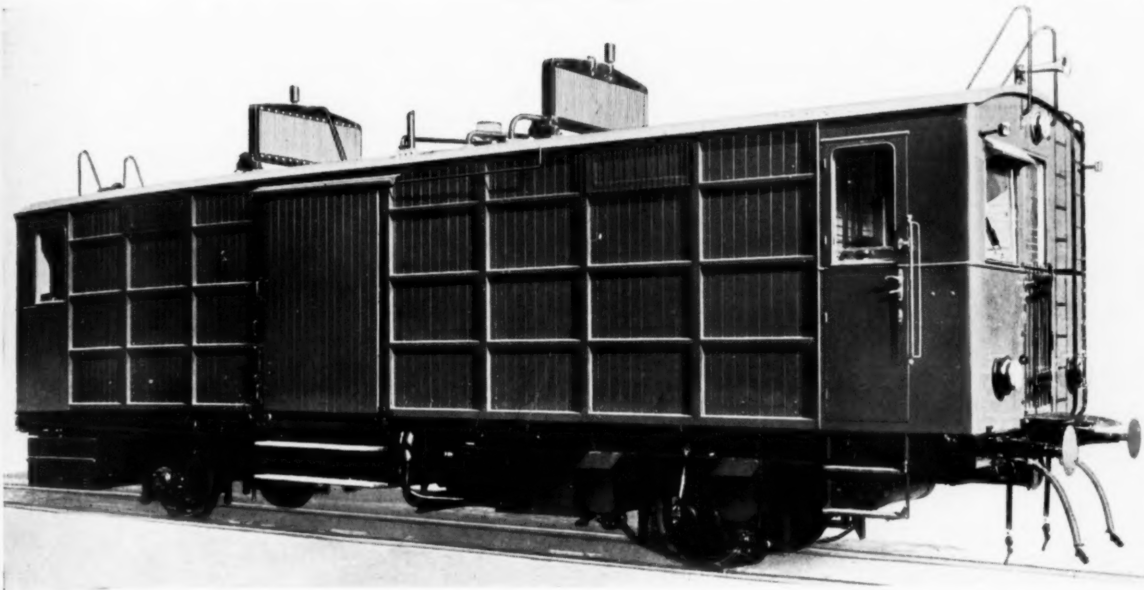
AS a result of continued search for more economical methods of operation to counteract the reduction in revenue, the Czechoslovak State Railways has in the last three years become the largest user of railcars in Europe. In 1931 the stock included 145 railcars, a total which was advanced to 223 in 1932 and 248 in 1933. During the course of the last nine months orders have been placed for no fewer than 162 vehicles, and it is anticipated that by the summer of next year approximately 400 railcars will be at work.

Diesel traction was not inaugurated until 1931, but rapid progress has been made since that date. In the issue of this Supplement for November 3, 1933, were described three classes of vehicle, and in the issue for June 15 last, the Blue Arrow, a new diesel-electric express running between Prague and Bratislava, was illustrated and described in detail. The newest types of railcars, which form the subject of this article, embody a number of advanced features, such as horizontal diesel engines situated below the floor of the car, and are also interesting in that several of them are fitted up as goods cars and operate solely on local freight trains.

Three principal types of railcar have been developed to suit the present requirements of the Czechoslovak State Railways, and are classified according to the maximum axle load, viz., 8, 12, and 14·5 tons. They have been



General view of 120 b.h.p. diesel-electric railcar of class M.232, Czechoslovak State Railways



120 b.h.p. diesel-electric goods car with horizontal engine, Czechoslovak State Railways

built in sizes from 100 to 400 b.h.p., and an effort has been made to standardise a number of components over as many types as possible. A number of Czechoslovak firms have participated in the construction of the various sizes of vehicle, but the examples covered in this article have been built by the Skoda works, at Pilsen.

The four-wheeled cars of class M.232 are made with 120 and 160 b.h.p. diesel engines, and the weight of the higher powered car is little greater than that of the vehicle shown in the first three illustrations. The power unit consists of a horizontally-opposed engine developing a rated output of 120 b.h.p. at 1,600 r.p.m. in eight cylinders of 110 mm. (4·33) bore by 150 mm. (5·9 in.) stroke. The fuel injection pumps are carried at the forward end, and at the other extremity the engine is directly attached to a 78 kW. electric generator. This application is interesting in that no part of the power or transmission equipment projects through the car floor, but this favourable result is largely due to the high rotational speed of the engine, which keeps down to a minimum the size of the generator. The complete engine-generator unit, including radiators, is supported elastically on the main cross members of the car underframe.

Light all-steel welded construction has been used for the body and underframe, and the main members of the latter are so shaped and constructed that they form the water, fuel oil, and air piping. By these methods the tare weight of the vehicle has been reduced to 16·7 tons from the 19·4 tons of preceding types of similar power, despite an increase in seating capacity from 48 to 56. A driving compartment is fitted at each end of the car. Designed for standard gauge lines, this type of car runs on wheels of 880 mm. (34·5 in.) diameter spread over a base of 6·2 m. (20 ft. 5 in.); the length over buffers is 12 m. (39 ft. 6 in.), the maximum width 2·95 m. (9 ft. 8 in.), and the greatest height 3·12 m. (10 ft. 3 in.). The maximum speed is 60 km.p.h. (37·3 m.p.h.), and when operating on slow schedules over level lines, two or three light trailers of special design can be hauled.

Of similar all-steel electrically-welded construction is the body and underframe of the goods car shown in the last of the accompanying illustrations. Being intended more for slow speed haulage work, the generator and traction motor characteristics are somewhat different from the passenger units, but the controls, including a dead-man handle device, are the same.

Diesel Traction in Ceylon

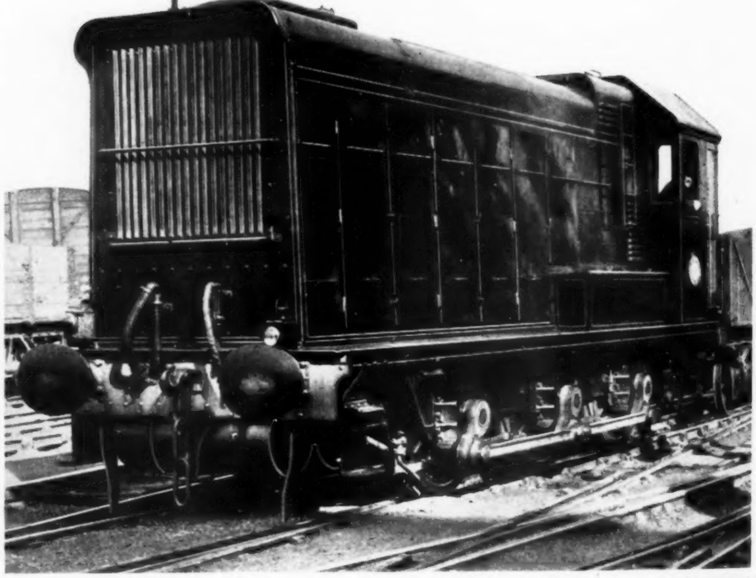
THE announcement that two Armstrong-Whitworth 800 b.h.p. diesel-electric locomotives are to be shipped for trial on the Colombo-Talaimannar mail trains of the Ceylon Government Railways follows a lengthy and interesting debate in the Ceylon State Council. At the beginning of July the Minister of Communications and Works presented the report of a sub-committee on the proposal to introduce three broad-gauge light-weight diesel-electric trains consisting of four vehicles each, which were to be used for suburban and inter-urban passenger service. The estimated cost was Rs. 836,400. An amendment to postpone acceptance of the report was carried, but the Minister then moved that sanction be given to accept an offer from Armstrong-Whitworth for the loan of two diesel-electric locomotives for a period of six months. The engines were to be maintained by the owners, but the railway department would supply the drivers and pay Armstrong-Whitworth 75 per cent. of the cost of steam traction for the same mileage. If the trials were successful, the railway department would have the option of purchase. Calculations showed that a saving of about Rs. 30,750 would be possible during the six months, and they would have a good opportunity of testing diesel locomotives.

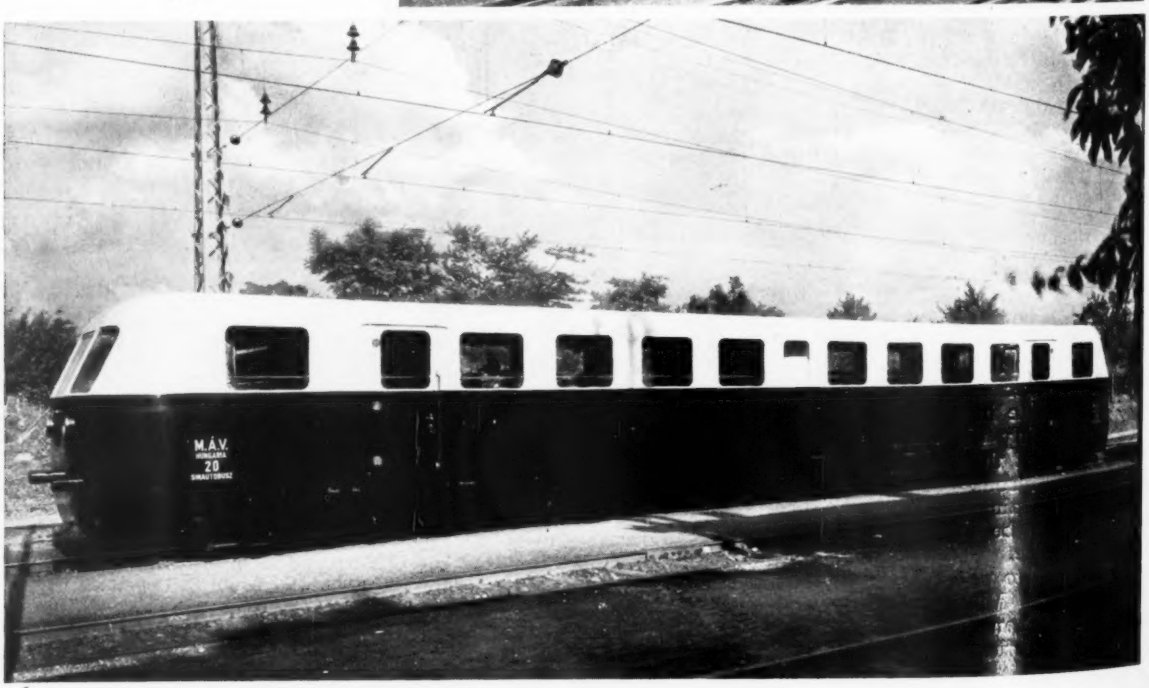
A member pointed out that an offer had been made to them, and by accepting it they were under no obligation to purchase the locomotives if they were not satisfied with them, and this was confirmed by the Minister, who said that if the two locomotives proved successful in reducing the working expenditure it would be left to the House to call for open tenders for those or any other kind of engine.

Above: Diesel-electric railcar used on the secondary lines of the Italian State Railways in Sicily. The car was built in the railway workshops and fitted with a 150 b.h.p. M.A.N. oil engine. The car has a maximum speed of 37 m.p.h., a tare weight of 33 tons, and a seating capacity of 45 in two classes

Right: Six-wheeled diesel-electric shunting locomotive built and owned by the English Electric Co. which is now running on the L.M.S.R. The weight is 47 tons and the engine output 300 b.h.p. The mechanical portion was built by Hawthorn, Leslie

Below: The latest type of 275 b.h.p. Ganz-Jendrassik diesel-electric railcar on the Hungarian State Railways. The vehicle illustrated has been running trial trips on the Budapest-Hegyeshalom main line



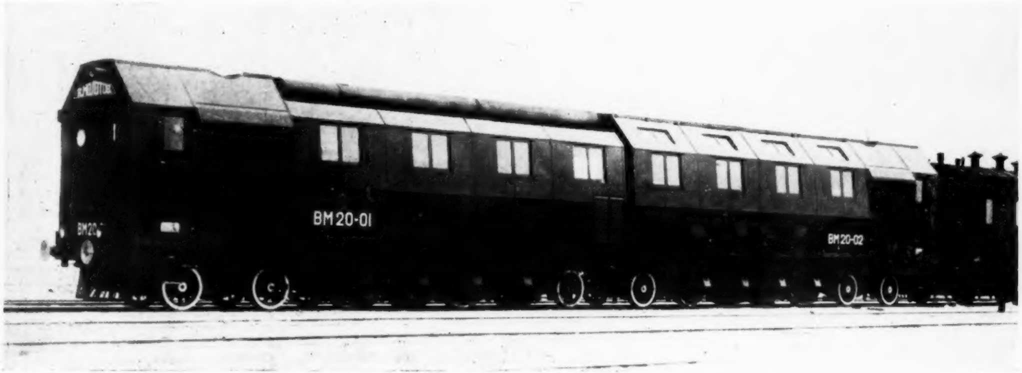


NEW HIGH-POWERED RUSSIAN DIESEL LOCOMOTIVE

Twin-unit design for heavy freight work

DIESEL locomotive design in Russia has progressed more or less upon a continuous plan, since its early days under Professor Lomonossoff's guidance, and although various causes have contributed to retard the furtherance of a definite policy, most of the major technical problems have been solved. Within the last two years a number of units have been constructed wholly in Russia, and the most recent locomotive in this category is shown in the accompanying illustration.

Increased freight traffic over the lines worked by diesel traction made desirable a large increase of power compared with previous oil-engined locomotives in the U.S.S.R., but in order to provide a unit with some flexibility from the traffic operating point of view, a twin construction was adopted, each half of which can be run separately as a 2-Do-1 uni-directional machine of 1,200 b.h.p. Compared with the previous 2-Eo-1 goods locomotives with the same type of engine, the present design is interesting as showing the increased maximum axle load of 20 metric tons now permitted on many Russian lines, and as an indication of how unit weights have been reduced during the last two years. The adhesion weight of 80 tonnes (78·8 tons) is 12 tons less than that of the latest 2-Eo-1 locomotives, although the maximum tractive effort of 20,000 kg. (44,100 lb.) developed by each half is the same. The weight of 129·5 tonnes (127 tons) of the 1,200 b.h.p. unit is 8 tons less than that of the 2-Eo-1 locomotives, giving a ratio of 237 lb. per b.h.p. against 252 lb. The complete 2-Do-1+1-Do-2 locomotive of 2,400 b.h.p. scales 259 tonnes (254 tons), and is suitable for a maximum speed of 55 km.p.h. (34·2 m.p.h.).



Latest 2,400 b.h.p. diesel-electric goods locomotive, U.S.S.R.

Well-Tried Oil Engine

The diesel engine is of the type used in all the earlier 1,200 b.h.p. locomotives, viz., the old six-cylinder four-stroke M.A.N. submarine pattern with modernised details. The engines for this locomotive were built under licence at the Kolomna works. They have cylinders of 450 mm. (17·7 in.) bore by 420 mm. (16·5 in.) stroke, and develop their rated power at 425-450 r.p.m. Judged by railway standards the engines are decidedly heavy, and weigh approximately 27 tons each. The arrangement of the improved Lomonossoff cooler has been modified in order to give the driver a better look out, and is now located between the driving cab at the end and the engine room in the centre. All the water and oil cooling elements are now mounted on the side of the locomotive, with the electrically-driven fan in the roof, just ahead of the silencer, which extends along the length of the engine room roof. Each 1,200 b.h.p. unit carries 2,500 kg. (5,500 lb.) of fuel, 800 kg. (1,760 lb.) of lubricating oil, and 1,028 kg. (2,270 lb.) of water.

A d.c. generator and attached exciter are directly coupled to the main engine, and both are force-ventilated. Together with the four nose-suspended traction motors, they were built by the Dynamo works at Moscow. Each traction motor has a capacity of 140 kW., but with a maximum rating of 154 kW. when operating with 350 amp. at 440 volts. Twin gears with a ratio of 19:82 transmit the motor torque to the 1,220 mm. (48 in.) wheels. A 52-cell battery with a capacity of 81 amp. hr. at the three-hour rate of discharge is installed in each half unit for lighting purposes, and for driving the auxiliaries when the main engine is stopped.

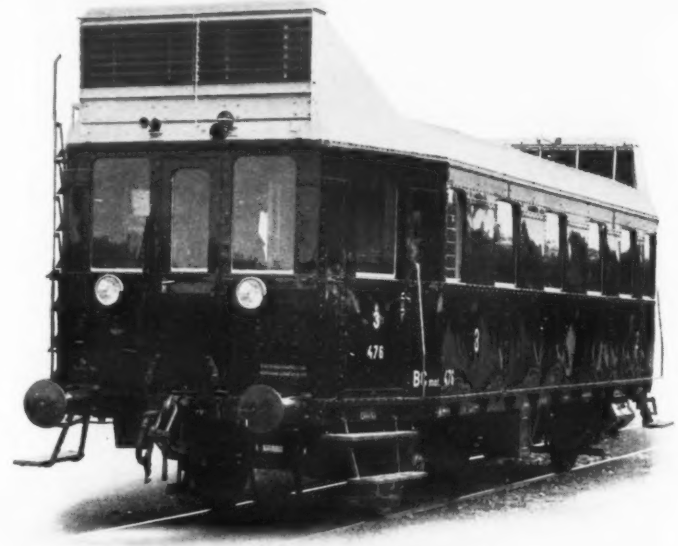
Outside plate frames are used as the foundation of the locomotive, and extend over a length of approximately 13·1 m. (43 ft.) for each half. Each set of driving wheels is spread over a base of 4·5 m. (14 ft. 9 in.), the total locomotive wheelbase is 23·1 m. (68 ft. 11 in.), and the length over buffers 27·2 m. (90 ft. 3 in.). The carrying wheels are 900 mm. (2 ft. $11\frac{1}{4}$ in) in diameter, and the two inner pairs are arranged in Bissel trucks with a transverse play limited to 60 mm. ($2\frac{3}{8}$ in.) per side. The pivots of the four-wheel bogies have a movement of 106 mm. ($4\frac{1}{4}$ in.) per side. All the controls are operated from a single desk in each driving cabin, but only one set can be operated at a time, depending upon the direction of motion.

It is understood that at the request of the staff of the Kolomna works this locomotive has been named *Viatcheslav Molotov* after the Russian aviator who took the leading part in the recent rescue of the 94 sailors marooned on an icefloe in the Arctic.

OPERATING RESULTS OF HUNGARIAN DIESEL RAILCAR

By the end of the present year the Hungarian State Railways will have in operation approximately 100 diesel railcars, the great majority of which will be powered by 100/120 b.h.p. Ganz oil engines. The first of these cars has been at work since 1928, and all are similar to the vehicles described in the *Diesel Railway Traction Supplement* for March 24 and April 21, 1933. The figures given in the attached table refer to car No. 476 which was put into service in 1929, and which is shown in the accompanying illustration.

At first sight the average annual mileage of 40,000 km. (25,000 miles) seems very low, but the car is engaged in slow stopping service, and the maximum designed speed is low. In the cost of maintenance shown in the table on this page the cost of a general overhaul is not included, but experience has shown that this adds 0·07 to 0·075 pengos per km. Adding this to the average total cost of operation and maintenance in the table, gives a figure of 0·345 pengos per km., equivalent to 2·98d. per mile at parity or 5·02d. per mile at the present rate of exchange.



The 100/120 b.h.p. diesel-mechanical railcar to which the table below refers. It has a maximum speed of 60 km.p.h. (37.3 m.p.h.), a four-speed gearbox, a seating capacity of 46 in two classes, and a tare weight of 19 metric tons

COST OF OPERATION OF 100-120 B.H.P. DIESEL-MECHANICAL RAILCAR NO. 476, HUNGARIAN STATE RAILWAYS

	Fuel consumption			Lubricating oil consumption		Cost of maintenance, pengos				Cost of operation, pengos						Cost of maintenance and operation, pengos	
Month	Kilometreage	Total kg.	Per train-km., gr.	Total kg.	Per train-km., gr. (1)	Wages	Material	Total	Per train-km.	Salary of engine driver (2)	Kilometre-money and premiums	Fuel	Lubrication, &c.	Total	Per train-km.	Total	Per train-km.
X.	3,164·3	925·5	310	64·5	20·2	27·78	10·28	38·06	0·010	178·80	121·71	241·71	137·72	686·94	0·22	724·00	0·22
XI.	3,533·4	1,182·0	334	77·5	21·8	47·91	9·16	57·07	0·016	386·30	139·10	366·42	165·14	1,056·96	0·25	1,114·03	0·27
XII.	3,384·6	1,228·5	380	98·0	29·0	41·32	1·70	43·02	0·014	212·80	133·33	319·41	209·76	875·30	0·27	918·32	0·28
I.	4,094·0	1,367·0	334	124·0	30·3	47·10	11·54	58·64	0·014	212·80	159·62	423·77	264·36	1,060·55	0·25	1,119·19	0·27
II.	3,857·2	1,311·5	340	119·0	30·9	9·10	30·00	39·10	0·010	386·30	152·64	406·57	261·87	1,207·38	0·31	1,246·48	0·32
III.	2,989·8	964·0	323	94·0	31·5	8·20	18·85	27·05	0·009	212·80	117·61	298·84	199·84	829·09	0·27	856·14	0·29
IV.	4,003·0	1,377·0	344	127·5	35·3	8·14	22·70	30·84	0·009	212·80	154·34	385·33	271·62	1,024·09	0·28	1,054·93	0·29
V.	3,174·6	1,126·5	375	37·5	12·5	14·80	74·04	88·84	0·030	386·30	106·59	349·22	39·43	881·54	0·29	970·38	0·31
VI.	3,738·0	1,371·0	367	61·5	16·4	8·14	21·17	29·31	0·007	212·80	133·74	425·01	62·66	834·21	0·20	863·52	0·23
VII.	3,195·4	1,253·0	394	47·5	14·8	8·88	38·40	47·28	0·010	212·80	116·11	388·43	49·53	766·87	0·24	814·15	0·25
VIII.	3,687·0	1,416·0	384	36·5	9·9	8·14	27·13	35·27	0·009	386·30	133·98	438·96	39·65	998·89	0·27	1,034·16	0·27
IX.	2,283·0	890·0	390	24·5	10·7	10·36	19·76	30·12	0·013	212·80	82·75	275·90	27·87	599·32	0·26	629·44	0·27
X.	2,620·0	1,032·0	394	28·0	10·6	3·70	18·85	22·55	0·009	176·20	83·83	319·92	29·53	609·48	0·23	632·03	0·24
XI.	3,533·4	1,273·0	360	32·5	9·2	12·58	5·94	18·52	0·005	386·30	118·14	394·63	35·12	934·19	0·26	952·71	0·27
XII.	3,458·4	980·0	284	36·5	10·5	22·94	23·56	46·50	0·014	212·80	113·57	303·80	39·04	669·21	0·19	715·71	0·21
	50,716·1	17,697·0	349	1,009·0	19·9	279·09	333·08	612·17	0·012	3,988·90	1,867·06	5,343·92	1,833·14	13,033·02	0·257	13,645·19	0·27

(1) During the period of October to April, the consumption of lubricating oil was very high, but modifications to the lubricating-oil system reduced it to a normal amount.
(2) Including rent for lodging.
(3) There are 27·8 pengos to the £ at par, and 16·5 at the present rate of exchange.

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(3) There are 27·8 pengos to the £ at par, and 16·5 at the present rate of exchange.